

WHAT IS CLAIMED IS:

1. A method for calibrating the work function of a non-contact voltage sensor,
comprising:

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preparing a reference sample to have a substantially stable work function;

measuring a voltage of the reference sample using the non-contact voltage sensor;
and

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determining a work function correction factor of the non-contact voltage sensor
from the measured voltage.

2. The method of claim 1, wherein the step of determining the work function
15 correction factor comprises determining a difference between the measured reference
sample voltage and a previously measured voltage of the reference sample.

3. The method of claim 1, wherein the step of determining the work function
correction factor comprises calculating the work function of the non-contact voltage
20 sensor from a known work function of the reference sample and preset voltage values of
the reference sample and the non-contact voltage sensor.

4. The method of claim 1, wherein the step of preparing the reference sample
comprises controlling an environment around the reference sample.

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5. The method of claim 4, further comprising

removing the reference sample from the controlled environment prior to
measuring the reference sample voltage; and

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returning the reference sample to the controlled environment subsequent to the step of measuring the reference sample voltage.

6. The method of claim 4, wherein the step of controlling the environment around
5 the reference sample comprises exposing an isolated chamber storing the reference sample to one or more environmental parameters, and wherein the step of measuring the reference sample voltage comprises terminating the exposure of the one or more environmental parameters to the isolated chamber.

10 7. The method of claim 4, wherein the step of controlling the environment around the reference sample comprises storing the reference sample in an isolated area.

8. The method of claim 4, wherein the step of controlling the environment around the reference sample comprises purging an area around the reference sample with an inert
15 gas.

9. The method of claim 8, wherein the step of purging comprises purging the area at time intervals between approximately 0.001 seconds and approximately 1 hour at a frequency between approximately 0.0001 Hz and approximately 1 KHz.

20 10. The method of claim 4, wherein the step of controlling the environment around the reference sample comprises illuminating the reference sample.

11. The method of claim 4, wherein the step of controlling the environment around
25 the reference sample comprises inducing a vacuum about the reference sample.

12. The method of claim 4, wherein the step of controlling the environment around the reference sample comprises maintaining the controlled environment at a temperature between approximately 20 °C and approximately 1000 °C for a time period between
30 approximately 1 second and approximately 1 hour.

13. The method of claim 1, wherein the step of preparing the reference sample comprises stripping a surface of the reference sample.
- 5 14. The method of claim 1, wherein the step of preparing the reference sample comprises forming a layer upon a surface of the reference sample.
15. The system of claim 1, wherein the reference sample comprises doped microelectronic materials.
- 10 16. The system of claim 1, wherein the reference sample comprises noble metals.
17. A method, comprising:
- 15 calibrating the work function of a non-contact voltage sensor; and
- adjusting a measured voltage of a substrate based upon the calibrated work function.
- 20 18. The method of claim 17, wherein the step of calibrating comprises:
- measuring a voltage of a reference sample; and
- determining a work function variance between the measured reference sample
- 25 voltage and a previous voltage measurement of the reference sample.
19. The method of claim 18, wherein the step of calibrating further comprises controlling an environment around the reference sample prior to and subsequent to the step of measuring the reference sample voltage.

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20. The method of claim 18, wherein the step of calibrating further comprises treating the reference sample prior to the step of measuring the reference sample voltage.

21. The method of claim 17, wherein the step of adjusting the measured substrate
5 voltage comprises subtracting the calibrated work function from the measured substrate voltage.

22. The method of claim 17, wherein the step of adjusting comprises adjusting a surface voltage measurement, a flatband voltage measurement, or a tunneling voltage
10 measurement of the substrate.

23. The method of claim 17, wherein the measured substrate voltage is obtained prior to the step of calibrating.

15 24. The method of claim 17, wherein the measured substrate voltage is obtained subsequent to the step of calibrating.

25. The method of claim 17, further comprising:

20 measuring voltages of a plurality of substrates subsequent to the step of calibrating; and

repeating the step of calibrating after measuring a subset of the plurality of samples.

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26. The method of claim 25, wherein the step of repeating is conducted between each voltage measurement of the plurality of samples.

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27. A system for determining an electrical parameter of a substrate, comprising:

a non-contact voltage sensor;

5 a substrate holder; and

an area isolated from the substrate holder, wherein the isolated area is adapted to
prepare a reference sample to have a substantially stable work function.

10 28. The system of claim 27, wherein the isolated area comprises a chamber
configured to hold the reference sample.

29. The system of claim 27, wherein the non-contact voltage sensor is a Kelvin probe,
a Monroe probe, or an atomic force microscope probe.

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30. The system of claim 27, further comprising a stage upon which the substrate
holder is arranged.

31. The system of claim 30, wherein the isolated area is arranged on the stage
20 adjacent to the substrate holder.

32. A corona discharge system, comprising:

a first beam shaping electrode; and

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one or more conductive rods extending into a space surrounded by the first beam
shaping electrode, wherein the one or more conductive rods are arranged at
an angle between approximately 0 degrees and approximately 90 degrees
with respect to a sidewall of the first beam shaping electrode.

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33. The corona discharge system of claim 32, wherein the one or more conductive rods comprise a plurality of needles suspended within the space surrounded by the first beam shaping electrode and concentrically spaced from each other by less than approximately 90 degrees.

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34. The corona discharge system of claim 32, wherein the one or more conductive rods comprise a plurality of wires extending between sidewalls of the first beam shaping electrode, wherein the plurality of wires are arranged parallel to each other and spaced apart by an amount between approximately 1 mm and approximately 5 mm.

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35. The corona discharge gun of claim 32, wherein the conductive rod is one of more than four conductive rods.

36. The corona discharge system of claim 32, further comprising a second beam shaping electrode spaced adjacent to the first beam shaping electrode, wherein a portion of the second beam shaping electrode overlaps a portion of the first beam shaping electrode.

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37. A corona discharge gun comprising a plurality of needles concentrically arranged less than approximately 90 degrees from each other.

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38. The corona discharge gun of claim 37, wherein the plurality of needles comprises more than four needles.

39. The corona discharge gun of claim 37, further comprising a first beam shaping electrode surrounding the plurality of needles, wherein at least one of the plurality of needles is angled between approximately 0 degrees and approximately 90 degrees with respect to a sidewall of the first beam shaping electrode.

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40. The corona discharge gun of claim 39, further comprising

a second beam shaping electrode spaced adjacent to the first beam shaping
electrode; and

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a third beam shaping electrode spaced adjacent to the second beam shaping
electrode.

41. The corona discharge system of claim 40, wherein at least one of the second and
10 third beam shaping electrodes comprises an opening having a width between
approximately 5 microns and approximately 4 cm.

42. The corona discharge system of claim 40, wherein at least one of the second and
third beam shaping electrodes comprises a tapered opening.

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43. The corona discharge system of claim 40, wherein at least one of the second and
third beam shaping electrodes comprises an opening, and wherein portions of the at least
one beam shaping electrode forming the lateral boundaries of the opening are rounded.

20 44. A device adapted to discharge a corona charge, comprising:

a first beam shaping electrode; and

a second beam shaping electrode at least partially inset within a space surrounded
25 by the first beam shaping electrode.

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45. The device of claim 44, wherein the second beam shaping electrode is inset at
least approximately 0.1 inches into the space surrounded by the first beam shaping
electrode.

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46. The device of claim 44, wherein a portion of the second beam shaping electrode inset within the space surrounded by the first beam shaping electrode is configured to surround a space having a width which is approximately 0.2 inches to approximately 1.0 inch smaller than a width of the space surrounded by the first beam shaping electrode.

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47. The device of claim 44, further comprising a conductive rod suspended within the space surrounded by the first beam shaping electrode.

48. The device of claim 44, further comprising a conductive rod suspended within a
10 space surrounded by the second beam shaping electrode.

49. A corona discharge gun, comprising:

a corona excitation source; and

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a first beam shaping electrode adapted to guide and discharge corona charged ions through an opening within the first beam shaping electrode, wherein the corona discharge gun is adapted to have a distance between the corona excitation source and the opening altered.

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50. The corona discharge gun of claim 49, wherein the first beam shaping electrode is adapted to contract and expand.

51. The corona discharge gun of claim 50, wherein the first beam shaping electrode
25 comprises telescoped sidewalls.

52. The corona discharge gun of claim 50, wherein the first beam shaping electrode comprises accordion-style sidewalls.

53. The corona discharge gun of claim 49, further comprising a second beam shaping electrode interposed between the corona excitation source and the first beam shaping electrode.

5 54. The corona discharge gun, of claim 53, wherein at least one of the first and second beam shaping electrodes is adapted to move relative to the other.

55. The corona discharge gun of claim 53, wherein the corona excitation is suspended within the second beam shaping electrode and is configured to move relative to an end of
10 the second beam shaping electrode.